Water Management Services Limited

ASSESSMENT OF REGIONALIZATION OF SOLID WASTE DISPOSAL SITE BATHURST, N. B.

TO

NEW BRUNSWICK DEPARTMENT OF TRANSPORTATION

AND

THE CITY OF BATHURST

FROM

WATER MANAGEMENT SERVICES LIMITED

AND

ROY CONSULTANT LTEE-LTD.

MARCH 1985

Water Management Services Limited

P.O. BOX 1116, 776 McLEOD AVENUE, FREDERICTON, N.B., CANADA, E3B 5C2
TELEPHONE: (506)457-2535, TELEX: 014-46341

85 03 22

Department of Transportation
P.O. Box 6000
Fredericton, N. B. E3B 5H1

ATTENTION: **Mr. Gilles Beaulieu, P.Eng.**

RE: **Assessment of Regionalization of Solid Waste Disposal Site, Bathurst, N. B.**

The attached report presents the results of our study for the above noted project. The work was carried out in accordance with the terms of reference of our proposal dated 84 08 31.

The report contains all of our study findings and presents recommendations and a conceptual plan and layout for regionalization of the Bathurst Solid Waste Disposal Site.

Should you have any questions regarding the attached, please contact us. Twenty (20) report copies are submitted.

Yours very truly,
WATER MANAGEMENT SERVICES LIMITED

Victor K. Nowicki, M. Sc.

Paul S. Belyea

Paul S. Belyea, P.Eng.
Attachments

ASSESSMENT OF REGIONALIZATION OF SOLID WASTE DISPOSAL SITE BATHURST, N. B.

TO

NEW BRUNSWICK DEPARTMENT OF TRANSPORTATION

AND

THE CITY OF BATHURST

FROM

WATER MANAGEMENT SERVICES LIMITED

AND

ROY CONSULTANT LTEE-LTD.

MARCH 1985

TABLE OF CONTENTS

		PAGE
1.0	INTRODUCTION	1
2.0	LOCATION AND SITE DESCRIPTION	1
3.0	TOPOGRAPHY AND DRAINAGE	2
4.0	GEOLOGY	3
	4.1 Soils	3
	4.2 Bedrock	5
	4.3 Hydrogeology	6
	4.4 Water Quality	8
5.0	DEMOGRAPHY AND ZONING	9
6.0	EXISTING WASTE DISPOSAL OPERATION	10
7.0	SITE ACCEPTABILITY AS A REGIONAL LANDFILL	13
8.0	REGIONAL LANDFILL CONCEPT	16
	8.1 Waste Quantities	16
	8.2 Land Ownership, Layout and Site Size	17
	8.3 Methods of Landfilling	18
	8.4 Projected Operation	20
	8.5 Filling and Covering Sequence	21
	8.6 Initial Site Preparation	23
	8.7 Special Waste Acceptability	25
	8.8 Waste Considered Acceptable for Disposal Area	26
	8.9 Other Special Wastes	29
	8.10 Site Access Roads	30
	8.11 Buffer Zone	31
	8.12 Rodent Control	31
	8.13 Gas Control	32
	8.14 Surface Water Control	32
	8.15 Fire Protection	33
	8.16 Litter Control	34
	8.17 Leachate Control	35
	8.18 Dust and Noise Control	39
	8.19 Salvage Area	39

	PAGE
8.20 Scavenging	40
8.21 Equipment Requirements	40
8.22 Maintenance Building and Associated Structures	40
8.23 Reclamation	42
8.24 Cover Requirements	42
8.25 Monitoring	43
8.26 Closure of Existing City Landfill Area	45
9.0 ECONOMIC ASSESSMENT	45
9.1 Capital Cost Estimates	45
9.2 Annual Operating Costs	46

LIST OF FIGURES

Figure 1	Site Location Plan	follows page 1
Figure 2	Sampling Locations	pocket at back
Figure 3	Sources of Cover Material	follows page 2
Figure 4	Groundwater Flow System, Overburden	follows page 7
Figure 5	Groundwater Flow System, Bedrock	follows page 7

LIST OF DRAWINGS

2665-1	Site Layout and Filling Sequence
2665-2	Leachate Collection System
2665-3	Final Site Layout
2665-4	Details, Regional Landfill

ASSESSMENT OF REGIONALIZATION OF SOLID WASTE DISPOSAL SITE BATHURST, N. B.

1.0 INTRODUCTION

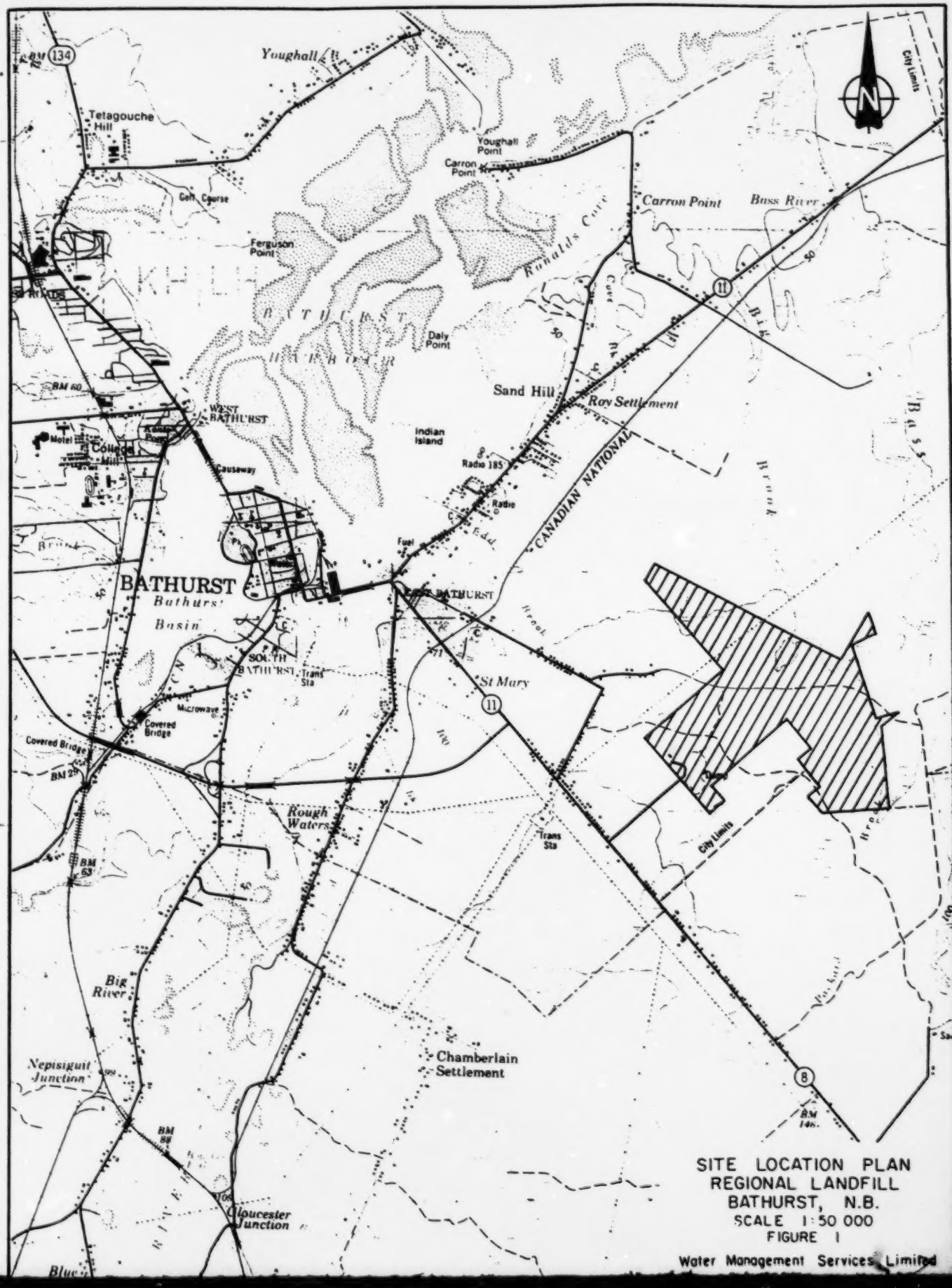
The Belledune Planning Region is presently searching for a new solid waste disposal site. As part of this review the possibility of converting the existing site used by the City of Bathurst to a regional site, to receive wastes from both jurisdictions, is to be investigated. The report addresses the suitability of site conversion and proposes a conceptual design to achieve this.

2.0 LOCATION AND SITE DESCRIPTION

The City of Bathurst landfill site is located in East Bathurst, on land owned by the City, approximately 0.6 mile (1 km) east of Highway 8, (Figure 1). In total the site consists of approximately 780 acres (315 hectares) with a perimeter distance of 17.2 miles (27.7 km). The large site perimeter results from the unusual shape of the property.

Of the available land only 460 acres (187 hectares) is proposed for landfilling. The site presently receives not only domestic waste from Bathurst residents but also sludges from the sewage and waste treatment plants, wastes from the Bathurst Consolidated Paper Mill and occasionally small carcases. Waste is brought to the site by private vehicles and by the two refuse collection trucks owned and operated by the City.

The landfill operation method is by area filling and the site is presently open Monday to Friday between the hours of 8 AM and 5 PM.



SITE LOCATION PLAN
REGIONAL LANDFILL
BATHURST, N.B.
SCALE 1:50 000
FIGURE 1

Water Management Services Limited

3.0 TOPOGRAPHY AND DRAINAGE

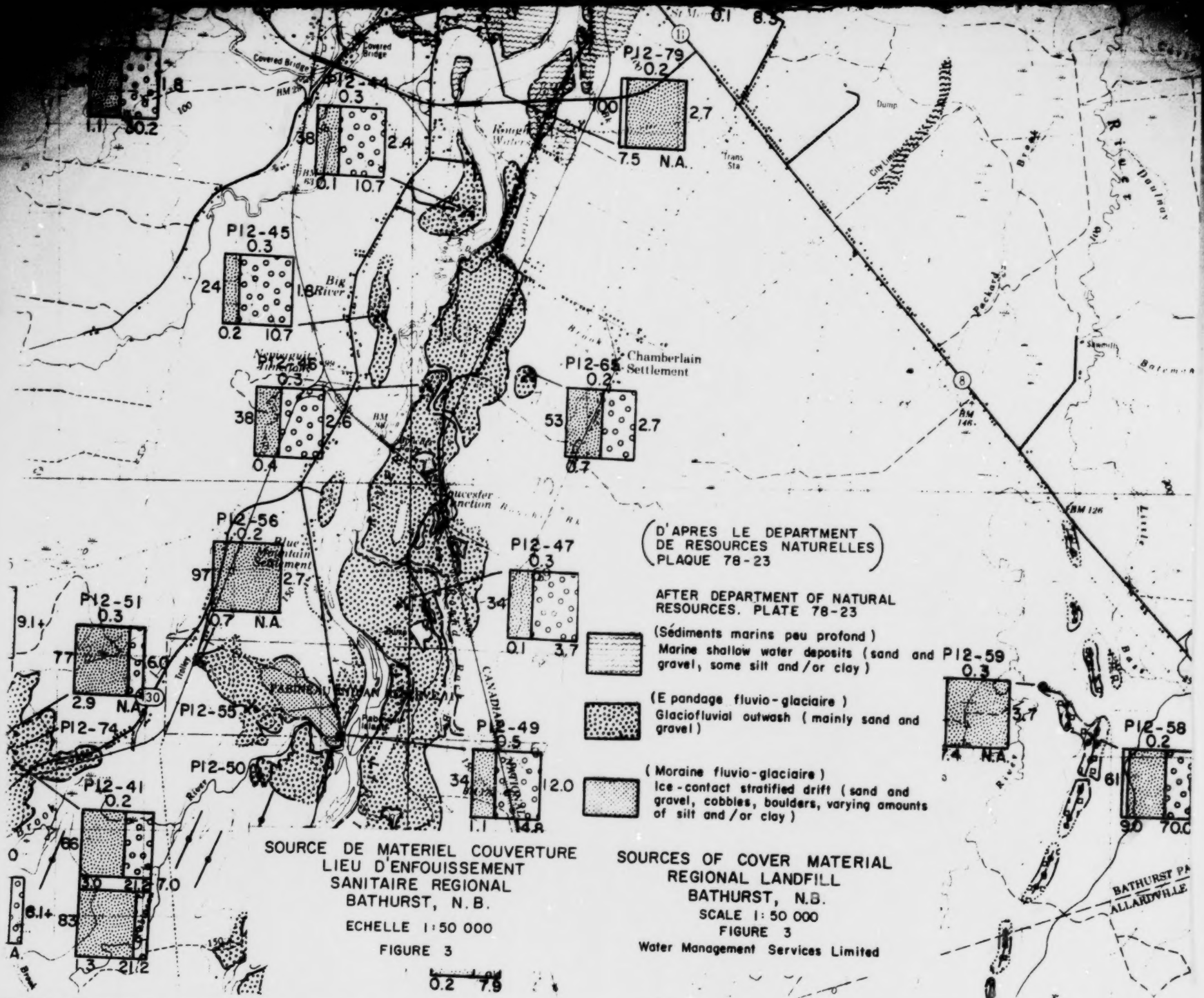
A flat to gently sloping topography characterizes the site with eastward gradients of less than 0.01. The only topographic feature of note is a low ridge which roughly parallels the south eastern site boundary. Immediately to the south and west the land surface gently rises to maximum elevations of 60 m while elevations on site range from 45 to 33 m.

The gentle slopes and thick vegetation cover restrict precipitation run off resulting in small temporary areas of standing water, swamps and boggy sections. The underlying impermeable clay soils also restrict downward loss of the river.

Two small intermittant streams cross the property. Neither of these encounter the area presently used for landfilling (Figure 2).

These streams flow generally south to north and each drains to a major swamp which, in times of heavy precipitation, often supports large area of standing water. Both streams are tributaries to Big Brook which flows northwards to enter the Bass River immediately prior to discharge in Nepisiguit Bay.

Peters River
P12-32
0.6
6.1
5.6
P12-8
0.6
51.5
2.7
1.1
41
37°
Youghall Beach
Youghall Point
Ronalds Cove
P12-22
1.5
100
3.0
N.A.
KH
P12-48
0.3
100
3.6
11.2
N.A.
P12-24
0.5
85.5
2.7
1.8
BATHURST
Bathurst
Basin
P12-34
P12-76
0.3
86
1.5
2.9
N.A.
P12-77
0.3
100
1.5
0.4
N.A.
P12-78
0.2
44
1.8
0.1
8.5
P12-79
0.2
P12-68
0.3
1.8
Auto Wreckers
Trailer Court
Theatre
City Limits
Causeway
Covered Bridge
Radio 185
Bass Brook
Brook
RIVER


PI2-79
0.2
2.7
7.5 N.A.
PI2-44
0.3
38
2.4
0.1 10.7
PI2-45
0.3
24
1.8
0.2 10.7
PI2-46
0.3
38
2.6
0.4
PI2-65
0.2
53
2.7
0.7
PI2-56
0.2
97
2.7
0.7 N.A.
PI2-47
0.3
34
0.1 3.7
PI2-51
0.3
77
6.0
2.9 N.A.
PI2-55
PI2-74
PI2-49
0.5
34
12.0
1.1 14.8
PI2-50
PI2-41
0.2
66
3.0 21.2 7.0
8.3
1.3 21.2
PI2-59
0.3
3.7
1.4 N.A.
PI2-58
0.2
61
9.0 70.0
Chamberlain Settlement
Blue Mountain Settlement
Covered Bridge
Dump
Trans Sta
Bik River
Rabbit Island
Trafalgar
Packard
Bateman
BM 148
BM 126
CANADIAN NATIONAL RAILWAY
BATHURST PA
ALLARDVILLE
(D'APRES LE DEPARTMENT DE RESOURCES NATURELLES PLAQUE 78-23)
AFTER DEPARTMENT OF NATURAL RESOURCES. PLATE 78-23
(Sédiments marins peu profond)
Marine shallow water deposits (sand and gravel, some silt and/or clay)
(Epandage fluvio-glaciaire)
Glaciofluvial outwash (mainly sand and gravel)
(Moraine fluvio-glaciaire)
Ice-contact stratified drift (sand and gravel, cobbles, boulders, varying amounts of silt and/or clay)
SOURCE DE MATERIEL COUVERTURE
LIEU D'ENFOUISSEMENT
SANITAIRE REGIONAL
BATHURST, N.B.
ECHELLE 1:50 000
FIGURE 3
SOURCES OF COVER MATERIAL
REGIONAL LANDFILL
BATHURST, N.B.
SCALE 1:50 000
FIGURE 3
Water Management Services Limited

4.0 GEOLOGY

4.1 Soils

The general area of the site displays the influence of glacial and recent depositional history on the soil types and their occurence (Figure 3). Numerous granular deposits have been mapped in the area. These consist of glaciofluvial outwash sands and gravels with minor amounts of silt and clay, ice contact drift of mainly sand and gravel and shallow marine deposits of sand, gravel, silts and clays in varying proportions.

Deposits of these types have been mapped in East Bathurst, along the Nepisiguit River and at various places westwards from there. These soils are apparently the nearest granular soils available to the landfill, although small deposits of ablation tills (pebbles, sand, silt and clay) do occur north of the site along the upper reaches of Little and Bass Rivers.

These soils are characteristically granular occurring up to 12 ft (3.5 m) in depth but are generally somewhat less than this. Beneath these soils, east of the Nepisiguit River, is found a dark red brown sandy silty clay. This unit appears to underlie much of the area to the east of the river and more particularly underlies the proposed site.

water management services

The site soils typically demonstrate a surficial unit of light to dark brown silty gravelly sand. Over the area of the site presently in use, this unit measures up to 6 feet (2 metres) thickness but often shows thicknesses less than this.

Test pitting, where access was available, in the undeveloped portions of the site revealed a similar unit. Seismic profiling indicated that in the extreme eastern section of the site a low ridge of this unit may provide thicknesses of 9 ft (3 m) or more. Generally speaking, however, the gravelly sand and silt averages 3 ft (1 m) across the site.

Boreholes (TW 1, TW 4) and seismic profiles (S1, S2) showed that the underlying clay unit, along the southern site boundary of the existing site area, reaches depths of 32 ft (10 m) and overlies the bedrock (Figure 2). Boreholes (TW 5) showed total overburden depths to be greater than 50 ft (15 m) and the clay layer to be underlain by a silty gravel. This gravel unit, due to caving could not be penetrated beyond a maximum of 6.5 ft (2 m). Groundwater levels however, indicated that this gravel unit may overlie the bedrock.

Along Currie Road two boreholes (TW 2 and TW 3) and two seismic profiles (S4, S5) gave an overburden profile consisting of 3 ft (1 m) of silty sand underlain by gravelly silty clay. This unit continued to a depth of 50 ft (15 m) in both boreholes where the unit became extremely hard to drill and contained a higher percentage of small gravel and pebbles. Bedrock was located at 58 ft (17.6 m) in TW 2 while drilling to 85 ft (26 m) in TW 3 encountered no rock.

Inspection of the test trench dug to assess excavation capability of the gravelly clay indicated the presence of several thin light brown sand lenses often no more than 1 ft (0.3 m) in length and less than an inch in thickness. This clay unit is extremely dense and was not easily dug by the bulldozer. The high percentage of clay and the density indicates that permeabilities can be expected to be less than 10^{-3} gal/day/ft (10^{-7} cm/sec).

It is possible that permeabilities may be greater than this at depth. The small sand lenses and more gravelly nature of some deeper deposits however, may serve to locally increase the permeability. An average permeability of 10^{-3} gal/day/ft (10^{-7} cm/sec) therefore is considered to be applicable for the clay soils.

Grain size analysis are presented in the Appendix A with test pit and borehole logs in Appendix B.

4.2 Bedrock

The bedrock beneath the site consists of red to brown sandstones, siltstones, shales and conglomerates of Mississippian age. There strata are near horizontally bedded with a dip of a few degrees to the east. The different bedrock facies vary from a few centimetres to several metres in thickness.

The Mississippian rock is conformable upon Carboniferous sandstones and shales to the east while the western boundary is marked by a fault which brings these sedimentary units against Devonian igneous intrusive rocks.

Little structural deformation is evidenced in the bedrock and any faults present are expected to be minor.

The surface of the bedrock is not flat lying as reflected by the ground surface but rather falls steeply to form a deep channel the centre of which appears to lie to the east of the site possibly beneath the Bass River. Boreholes TW 1 and TW 4 encountered bedrock at depths of less than 32 ft (9.7 m) while in Borehole TW 2 and TW 5 bedrock was deeper than 50 ft (15 m). In Borehole TW 3 after 58 ft (17.6 m) of drilling no rock was encountered. At the Department of Transportation garage, approximately 1.0 mile (1.5 k) to the south, bedrock depth is 100 ft (30 m) while it goes to 148 ft (45 m) at the Highway Patrol office adjacent. Further south the bedrock again rises to shallow depths. North of the site along Packard and Currie Streets bedrock lies at depths of less than 50 ft (15 m).

4.3 Hydrogeology

Water levels across the site were determined using piezometers. Where feasible piezometers were installed at different levels in the same boreholes (multi-level).

Monitoring of water levels in the overburden and bedrock indicated the presence of three flow systems.

Groundwater flow in the bedrock and overburden soils is from southwest to north northeast, (Figures 4 and 5). Recharge takes place on the high ground located to the southwest of the site and across the site itself, while discharge is towards Bass River and Nepisiguit Bay. Vertical gradients measured across the site in the overburden varied from 0.37 to 0.85 in the shallow soils and 0.13 to 0.55 in the deeper soils. Where the bedrock lies within 50 ft (15 m) of the ground surface, gradients tended to be somewhat higher. Horizontal flow gradients varied from 0.0052 in the shallow soils to 0.02 in the deeper soils. Groundwater flow in the bedrock registered gradients of 0.008.

The low gradients in the soils and bedrock are a reflection of the small amount of precipitation experienced in the area since mid-summer. These gradients will change considerably when groundwater levels return to normal. The direction of groundwater flow however is not likely to change.

Water flows in the bedrock beneath the site (TW 1, TW 4) were estimated at 15 gal/min (1.14 L/s), while wells serving the maintenance building has an estimated yield of (10 gal/min) (0.75 L/s). Domestic wells drilled into bedrock and located along Highway 8 and Packard Street demonstrated yields of similar quantity.

SYSTEME D'ECOULEMENT PEU PROFOND

35.0 ——— PROFILE DU NIVEAU D'EAU (m)

←— — — DIRECTION D'ECOULEMENT

SYSTEME D'ECOULEMENT PROFOND

30.0 ═══ PROFILE DU NIVEAU D'EAU (m)

←— — — DIRECTION D'ECOULEMENT SOUTERRAIN

←·····DIRECTION D'ECOULEMENT ASSUME

LIMITE DU LIEU D'EMPLACEMENT

SITE BOUNDARY

35.0

27.5

30.0

32.5

37.5

35.0

37.5

40.0

40.0

HIGHWAY ROUTE 8 No. 8

RUE POPLAR STREET

SHALLOW FLOW SYSTEM

35.0 ——— WATER LEVEL CONTOUR IN METERS

←— — — GROUNDWATER FLOW DIRECTION

DEEP FLOW SYSTEM

30.0 ——— WATER LEVEL CONTOUR IN METERS

←— — — GROUNDWATER FLOW DIRECTION

←····· ASSUMED FLOW DIRECTION

SYSTEME D'ECOULEMENT SOUTERRAIN DANS LES MORTS-TERRAINS LIEU D'ENFOUISSEMENT SANITAIRE REGIONAL BATHURST, N.B.

ECHELLE 1:10 000

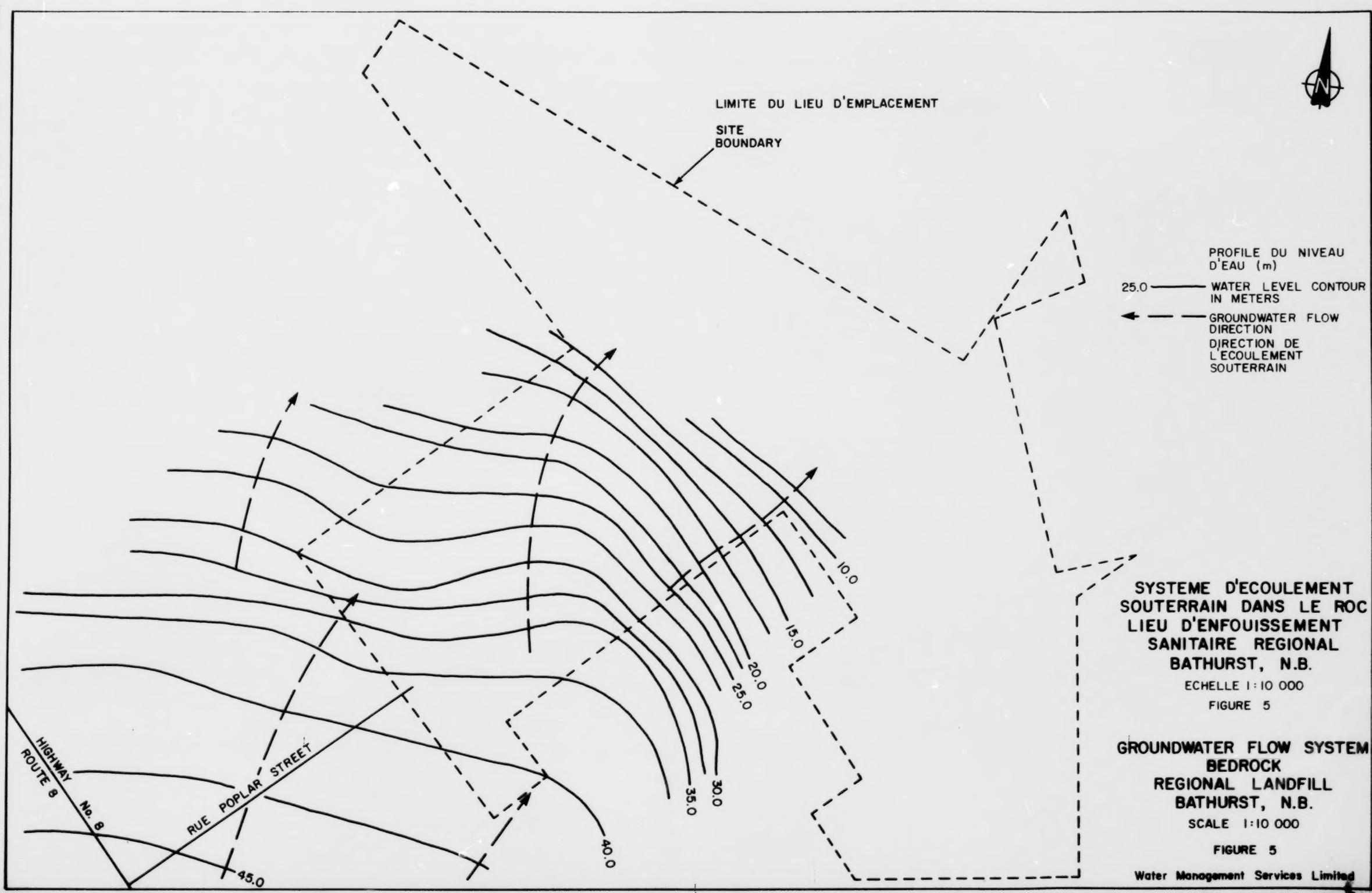
FIGURE 4

GROUNDWATER FLOW SYSTEM OVERBURDEN REGIONAL LANDFILL BATHURST, N.B.

SCALE 1:10 000

FIGURE 4

Water Management Services Limited



SYSTEME D'ECOULEMENT SOUTERRAIN DANS LE ROC
LIEU D'ENFOUISSEMENT SANITAIRE REGIONAL
BATHURST, N.B.

ECHELLE 1:10 000

FIGURE 5

GROUNDWATER FLOW SYSTEM
BEDROCK
REGIONAL LANDFILL
BATHURST, N.B.

SCALE 1:10 000

FIGURE 5

Water Management Services Limited

Water occurrances in the clay soil overburden are confined to the thin sandy and/or gravelly lenses that occur sporadically through the clay soils. Yields are low as recharge to these lenses is restricted by the surrounding impermeable soils. Small amounts of water also occurs in the gravelly silty clays which are located at depth beneath the eastern half of the site and were encountered in boreholes TW 2 and TW 3.

Permeabilities in the bedrock are estimated to range from 10^2 gal/day/ft (5×10^{-3} cm/sec) to 10 gal/day/ft (5×10^{-4} cm/sec) while the clay tills themselves demonstrate permeabilities less than 5×10 gal/day/ft (10^{-7} cm/sec).

4.4 Water Quality

Water samples were taken on selected piezometers, from the two on-site brooks and from the DOT garage. All samples were analysed for a full metal scan and selected major ions. The results are given in Table 1 (Appendix A). The locations of sampling points are shown on Figure 2.

The metal scan indicated all waters tested to contain low metal contents. Iron and manganese were the only exceptions to this. In TW 4 A, B and C and in TW 5A and TW 2A manganese was many times the acceptable limit. Iron was greater than the limit only in Brook sample WSP 7, a surface water. Although manganese levels are high they are not unusual for the area.

The pH varied considerably from a high of 9.0 in the DOT well to 6.4 in Brook WSP 2.

The high pH of 9 in the DOT well likely accounts for the low iron and manganese levels in this well.

Conductivity values were generally high. The wells ranged from 396 to 957 microhms/cm while brook WSP 7 recorded 154. The high conductivity in the wells likely results mainly from the elevated content of sodium calcium, sulphate and alkalinity.

In general the water quality analysis presented few surprises (except the high level a COD chemical oxygen demand). The high levels in wells TW 4A, 4B and TW 2A are indicative of high loadings of organic substances and cannot be explained with existing data. Normally one would conclude that the high COD values would result from landfill leachate, however no other parameters show typical leachate levels.

5.0 DEMOGRAPHY AND ZONING

The present landfill site property is relatively well located and well screened from the public. One access is open however, and that is Currie Street, a gravel road maintained by the City. This road which crosses the northern part of the property in an west-east direction is apparently used for occasional access to properties east of the landfill and by hunters.

Six homes are located on Currie Street; all but one is 0.6 mile (1 km) from the area of present active landfilling. The new proposed landfill area will bring an additional three homes on Currie Street and four homes on Packard Street within the 0.6 mile (1 km) zone. These homes however, still remain more than half a mile from the landfill area.

The nearest major subdivision lies approximately 1.2 miles (2 km) to the west. Development on Packard Street, Currie Street and along Miramichi Avenue (Highway 8) is considered ribbon development.

Zoning by the City restricts land usage in the area of the landfill property to minimum rural lots of 25 acres (10 ha) for development, while the 25 acres restriction also applies along Miramichi Avenue and Poplar Street. Zoning in the area is light industrial unless the lots existed prior to 1979. Along St. Mary's and Currie Steets similar provisions are in force, namely that prior to 1979, 1 acre (0.41 ha) lots applied while after 1979 the minimum lot size increased to 25 acres (10 ha) lots.

6.0 EXISTING WASTE DISPOSAL OPERATION

Site access is via a gravel road from the site entrance on Miramichi Road (Highway 8). A steel gate restricts entry except during open hours which are from 8 AM to 5 PM, Monday to Fiday.

Some on-site gravel roads allow access, for both private vehicles and city owned disposal trucks, to the landfill face. These roads are maintained with imported gravel and the use of city equipment. Gravel roads are extended when needed and as filling continues.

The disposal of refuse is undertaken using an area filling technique. Refuse is end dumped at the working face. A D6 bulldozer then pushes the refuse over the face compacting by continual passage across the refuse. The operating face is approximately 16 ft (5 m) high. The compacting bulldozer on top of the refuse has little effect on the refuse in the lower sections of the face. This however, is of little immediate consequence due to the large land area available.

Periodically the refuse is covered by soil using the same D6 bulldozer. Cover material is normally found from existing resources on site which are limited, and may not be adequate for continual daily cover. Cover material is also brought to the site, when available, from excavations in the city.

Recently a move towards deposition of refuse in distinct cells, rather than across a lengthy operating face, has taken place. The site has been plagued with refuse fires which when started are difficult and expensive to extinguish. Small distinct cells separated by soil walls will help prevent spreading of the underground fires and render fire fighting easier and less expensive.

The site accepts only domestic household waste and designated special wastes from the city water and sewage treatment facilities and occasionally small carcasses brought to the site by the SPCA or Natural Resources. The latter are buried in a designated area where small trenches are dug as needed. As with these carcasses, the sludges and liquids from the treatment plants are also disposed of apart from the general domestic wastes. Sludges are buried in narrow trenches, in a small designated area, to the north of the main working face. Liquid from the treatment facilities is disposed of in shallow trenches in completed portions of the landfill by percolation through the old wastes.

No septic tank wastes, oil and petroleum products, fish wastes or other special wastes are accepted at the site. Agricultural or food processing wastes and car bodies and metal structures are also not accepted. Special wastes such as urea formaldehyde foam (UFFI) are also rejected. These wastes, which not accepted at the city site, are likely disposed of at the Roughwater Dump which is administered by the Department of Transportation.

No leachate control is presently practiced at the site, however, a small dyke constructed by bulldozer around the working face appears to be reasonably effective in retaining any leachate produced. Evaporation reduces this volume to minor amounts. The use of on-site soil for final cover, contouring and sloping of completed landfill areas encourages runoff, prevents infiltration and hence reduces production of leachate.

A 200 ft (65 m) buffer-fire zone is maintained from the working face to the nearest treed areas.

7.0 SITE ACCEPTABILITY AS A REGIONAL LANDFILL

The solid waste disposal site presently owned and operated by the City of Bathurst and located east of Highway 8 is suitable for development into a regional disposal site. This conclusion is based on the following considerations:

A. Transportation of waste, ease of access and general location.

The site is located close to a main highway and the Bathurst bypass. The bypass will allow easy and efficient access from the Belledune Planning Area. These roads are in good condition and would have no problem accommodating a small increase in traffic. Site access is also good via a well kept gravel road (Poplar Steet).

B. Site size, availability and suitability of soils

Calculations later in report indicate that a 50 year land disposal operation will require approximately 260 acres (187 hectares) in area. The present site offers far more than this area and as such allows for selection of the best land for disposal operations and separate disposal areas for special wastes.

Evidence gathered during soils investigations indicated sufficient cover material available on site to allow for good operation and management of the disposal area. No soils (gravel) suitable for on-site road construction are available. These will have to be imported from nearby gravel pits.

On-site soils are clayey in nature and relatively impermeable. These soils are most effective in preventing loss of leachate from the site. Above the clay soils lies more granular soils which are suitable for use as site cover material.

C. Groundwater protection and direction of flow.

No use is made of the groundwater beneath the disposal site or to the east in the direction of groundwater flow. Contamination of public water supplies therefore is unlikely. Further protection of the groundwater is provided by the relatively impermeable clay soil which constitutes an effective barrier to contaminant migration.

D. Surface water protection.

Although two small intermittant streams cross the property, site design can effectively protect these waters from contamination by diversion and on-site surface water collection.

E. Pollution potential.

The site pollution potential is low. This can be credited to the low permeability soils, site isolation and good management.

F. Ease of disposal operation

The site is relatively flat and in general covered by dense growth. After clearing and grubbing the site can be developed with relative ease. Difficulties in the past have been experience with fires and working on the clay soils. Fire problems can be controlled with small cell construction and venting control of incoming fire causing agents, such as ash, will also help prevent fires. Good on-site roads and recognition and design for wet weather operations will eliminate operation difficulties.

Sufficient area is available to allow an area landfill concept to be used utilizing end dumping, spreading and compaction.

G. Isolation and screening.

Although within the city boundaries, the site is afforded good screening and buffering at its present location. Restrictions on development in the area will also assist in protection of the isolation of the site. The nearest residences are located on Highway 8 and along Packard and Currie Streets. The closest house is 2300 ft (700 m) from the disposal operations while in general this distance is greater.

H. Reclamation and reuse.

The site is within city boundaries and at the end of its useful life could easily be converted to open space uses. It is sufficiently close to the city centre to be accessible to all residents of Bathurst.

Reclamation of the site can and will take place as it develops. This spreads the costs of reclamation over the life of the site and allow stabilization and possible reuse of older parts of the landfill prior to site being filled.

8.0 REGIONAL LANDFILL CONCEPT

8.1 Waste Quantities

A survey of waste, brought to the landfill in 1982, from July 12th to 16th gave an average daily waste production of 18.64 tons (16.91 tonnes). Utilizing an existing population of 16,000 person this provides for 2.34 lbs (1.06 kg) of daily waste production per capita.

It is however, reasonable to assume that this production rate has changed somewhat since 1982 and that by the year 2,000 will have altered even more. It would be prudent therefore to assume a higher rate of waste production. The reasons are as follows:

- product use changes cannot be accurately projected and may increase or decrease.
- assumed population base for Bathurst (18,000 persons) and Belledune Region (22,000) including Belledune and Jacquet River is 40,000 persons. Fredericton's population base of 54,000 persons produced 3.1 lbs (1.4 kg)/capita/day in 1980.

- wastes such as car bodies, machinery, special wastes etc. are presently not accepted at the site but may be in future.

For design purposes a waste generation rate of 3.3 lbs (1.5 kg)/capita/day is used.

Daily waste generation is therefore calculated at 66 tons (60 tonnes). Daily waste volumes assuming a compacted in situ density of 60 lb/yd^3 (356 kg/m^3) are 220 yd^3/day (168 m^3/day) while yearly waste production will be 24,150 tons (21,900 tonnes).

Utilizing four(4) lifts of refuse 3 ft (1 m) in thickness the yearly requirement for waste disposal is 3.8 areas (1.54 h).

8.2 Land Ownership, Layout and Site Size

The proposed regional site is to be located on land owned by the city of Bathurst. A total land area of approximately 780 acres (315 ha) is available. Of this a portion is lost due to the presence of two NBEPC Powerline Right of Ways and land already utilized for landfilling. The remaining land however, is more than sufficient to provide disposal area for approximately 50 years of waste generation. The proposed Bathurst-Janeville Highway passes to the north of the landfill area and along the site boundaries. The site layout provides for a sufficient buffer (300 ft-100 m) between the highway and any landfilled area.

The general layout of the site is shown on Drawing 2665-1 (rear pocket). Approximately 400 acres (162 h) of the site is proposed for refuse disposal of this approximately 60 acres (24 h) is set aside to receive special waste such as oily debris, fish wastes and sludges. The general domestic refuse disposal area is divided into two areas designated Phase I and Phase II. Each has an approximate life of 25 years.

That portion of the available land area north of the NBEPC powerline L1152 is not designated for landfilling due to proximity to residences along the Currie Street and Packard Road and, the presence of a major wet area.

Areas to be considered for acquisition by the Owner of the proposed regional landfill are designated on Figure 2. Acquiring designated land is preferable from several view points: an acceptable buffer zone is created around the landfill; landfill construction is made more efficient by reducing perimeter ditching; and additional area is created for future landfilling thus making capital costs outlay more economically attractive. It is considered that an additional 25 years of landfilling may be available through these land purchases.

8.3 Methods of Landfilling

Two methods of landfilling are generally practiced at solid waste disposal sites, the area method and the trench method. Often, both methods may be practiced. In this case, the initial

operation is conducted by trenching to a predetermined depth, placing refuse in thin layers, compacting and covering, (trench fill). When soil depth and site area has been exhausted area landfilling takes place over the filled trenches by general spreading or end dumping of refuse, compacting and covering. Greater compaction and hence volume reduction is achieved through placing or spreading of refuse in thin layers 3 ft (1 m) rather than general end dumping. The passage of the compacting vehicle acts little on refuse greater than three feet below the landfill surface.

The present disposal method practiced by the City of Bathurst at the existing site is landfilling by the area method. The possibility of increasing the life of the existing and available land area through utilization of trenching prior to area filling, was investigated. The D-6 bulldozer presently used at the landfill was requested to excavate a trench. The bulldozer was able only to penetrate with relative ease to a depth of 3 ft (1 m). The hard compact sandy silty clay till underlying the site is too dense to allow economic excavation when compared to that of area landfilling and the extent of land area available.

The recommended method of refuse placement therefore is <u>area landfilling</u> with regular compaction.

8.4 Projected Operation

The site will operate using an area method of landfill. The conceptual plan designates year cells. These are shown in suggested sequence of filling. Filling will proceed from east to west from Currie Road toward present landfill area (Drawing 2665-1).

Initial year cell preparation consists of clearing and grubbing. Grubbed waste may be pushed to the perimeter of the landfill or into the 100 ft (30 m) fire break zone which surrounds the landfilled area.

Refuse deposition will be by end dumping with spreading and compaction by bulldozer. Daily cells will be approximately 3 ft (1 m) in thickness and 50 ft (15 m) by 40 ft (12 m) in area. Reasonable compaction will be obtained by the passage of the bulldozer during spreading.

Prior to waste deposition the ground surface will be stripped of available cover material. This material, generally speaking, is the gravelly sandy soil which occurs with an estimated average thickness of 3 ft (1 m) and overlies the dense brown clay till which underlies the site. This material should be stockpiled temporarily to the side of the active year cell, in the most convenient location for access and availability under adverse weather conditions. This material will be continually used for daily cover.

The clay till surface will then be sloped prior to installation of the leachate collection systems. This will produce clay soil for final cover material. This should be temporarily stockpiled or used immediately to form the final cover, and if necessary, the side slopes over the year cell previously completed.

8.5 Filling and Covering Sequence

The conceptual site layout designates the year cells and the recommended filling sequence (Drawing 2665-1). Filling should initially commence in year cell 1. This is located adjacent and to the south of the existing landfilled area. Filling of this cell will complete this section of the site and allow existing landfilling operations (City operations) to be closed, covered and reclaimed. Filling year cell 1 will also allow a one year grace period for construction of the regional landfill and initial site preparation work.

After completion of this cell, filling will move to year cell 2 located adjacent to the power corridor and Currie Street, and opposite the siltation ponds.

Filling will then pogress to cells 3, 4 and so on. Waste is to be deposited in 3 ft (1 m) deep daily cells and covered with approximately 6 inches (150 mm) of cover material (surficial soil unit) excavated from on site (drawing 2665-4). After approximately 90 days of refuse disposal the year cell first lift

(Lift 1) should be completed. Filling will then commence in the second lift. The third and fourth lifts will complete refuse disposal in the year cell. Filling will then move to the next designated year cell.

Daily cover applied on the day cells will in effect form a continuous layer between each lift. When the final 3 ft (1 m) lift (Lift 4) is complete the cell is covered by a minimum 2 ft (0.66 m) of native clay soil. This will form an impermeable cap to prevent infiltration of precipitation and subsequent leachate generation.

This clay soil will be obtained from excavation and sloping in the preceeding next cell and stockpiled until used. This work will be undertaken a few weeks before the final 4th lift is complete.

Clay soil will also be used to apply the 2 ft (0.66 m) cover on the side slopes of the cells forming the outer limit of landfilling.

As refuse will be placed in several 3 ft (1 m) lifts and covered by a 2 ft (0.6 m) final cover and the cells follow the existing topographic slope the final landfill contours will have a 1% to 2% slope to the north.

8.6 Initial Site Preparation

The conversion of the site to a regional facility necessitates a change in landfilling area and layout. A main road must be constructed to allow access to year cell 2 (drawing 2665-1). It is proposed to utilize the existing Currie Street where possible. It must however, be widened and upgraded to an all weather road. A new road must also be constructed from the gate to Currie Street. It is recommended that access to the general public along Currie Street be restricted if possible due to liability considerations. Currie Street should be served by a ditch and earth barrier topped by a wooden or steel gate. If closure of Currie Road is not acceptable due to roadway status then other options could be considered. Rerouting of Currie Road is possible. The preferred route would parallel the proposed Bathurst-Janeville Highway. This however would complicate access from the proposed highway to the site and would be an expensive undertaking. The option of fencing the road through the landfill is also possible. Apart from the obvious expense, maintenance of the fence may become a problem as would vandalism. A large portion of the potential site would also be physically separated from the active landfill areas. Traffic to that area would also have to cross the road. A third option is to provide access to the eastern portion of Currie Road via another access. This report considers only the restriction of access along Currie Road as transportation decisions outside of the site are beyond the scope.

The scale house and weigh scales, if it is decided to levy charges according to tonnage deposited, should be constructed while the road is under construction.

External site ditching must form part of the initial site preparation and is necessary to revent off-site surface runoff from penetrating the refuse.

On-site ditching to receive runoff from the active landfill must be constructeed together with the siltation ponds. Initial active landfill site ditching should be constructed to the limits of the first five years (year cells 2 to 6) of landfilling in the main area Phase I. As cell 1 is located adjacent to the existing landfill and the land is already cleared and grubbed no initial site preparation is necessary. At the western extremities of cells 3, 4 and 5 a shallow diversion ditch should be constructed by bulldozing, to lead overland runoff toward the perimeter ditching.

The land occupying year cell 2 and 3, and 200 ft (60 m) of year cells 4, 5 and 6 should be clear cut and grubbed. Surficial soil (granular material) should be excavated and stockpiled adjacent to the year cell.

The initial manhole of the leachate collection system and the necessary piping for the cell (cell 2) together with the gravel blanket should be laid. The pipe ends should be sealed temporarily and reopened when the piping is extended. The leachate collection system laid beneath cell 1 is to be sealed at the downstream and to be opened for connection when year cell 21 is under construction.

The 100 ft (30 m) fire break must be cleared around the outer perimeter of year cells 1 and 2. The fire break in the direction of active landfilling is provided by the partially cleared year cells 3, 4 and 5. The fire break will be extended as necessary and as filling progresses.

8.7 Special Waste Acceptability

At the present time the existing landfill receives no known special wastes except waste water treatment plant and sewage treatment plant sludges. These are properly disposed of in shallow narrow trenches in a small area separate from general landfilling activities.

The type and thickness of the underlying soils and the direction of the prevailing groundwater gradients indicate that special wastes, as defined, may be accepted and safely disposed of at the regional site if permission is obtained from the appropriate government authorities. A disposal site for special waste is shown on drawing 2665-1.

It is recommended however, that disposal practices be by trench burial in the designated area separate from general landfilling. This will enable these wastes to be properly recorded and disposed of under supervision. Consideration must be given to fencing the special waste disposal area if it is decided to accept these wastes.

8.8 Waste Considered Acceptable for Disposal Area

Oily Debris:

To include absorptive material and materials contaminated with oil. Oil sludges and clean up materials from oil spills.

The disposal of liquid oils and petroleum products is discouraged unless permission is obtained from the Owner and the Department of the Environment. If such disposal is approved a special trench should be dug to contain the petroleum product. Such disposal however, should be considered to be temporary and as storage until the waste can be either spread sparingly over the general landfill area under supervision, or incinerated in small quanities. However, less than 50 gallons (225 litres) may be accepted for permanent disposal and placed in a trench along with general oily wastes.

The trench should be shallow and dug no deeper than 6 ft (2 m) into the clay soil after the granular material has been removed. The sludges etc. will be covered as each trench is filled.

No statistics are available from which to estimate oily waste debris quantities as the majority of this kind of waste is generated by accidental loss. Should the trenches provided be insufficient then areas of the landfill not presently designated for landfill be brought in to use.

The designated oily debris disposal area however is estimated to accommodate a 500,000 gallon oil spill and the clean up debris associated with the spill.

Oil spillage data on file with the Department of the Environment show that over 10 years approximately 150,000 gallons of oil are spilt annually.

Fish Wastes:

To include both hard and soft parts rejected during fish processing but only to include organic material from processing.

Decaying fish waste presents two difficult problems, the odour and the generation of organic acids.

Odour problems will be overcome by immediately burying or covering the waste upon disposal in the trench. This necessitates an accepted disposal schedule recognized by the fish processes and the owner. Wastes will only be accepted at designated times.

Acid production problems may be alleviated to some degree by liming the wastes. If lime is available this practice should be periodically undertaken.

Disposal of these wastes should be in shallow trenches dug immediately prior to filling or as convenient providing that little precipitation be allowed to accumulated in the trench. The granular soil should be removed prior to trench excavation.

Fish wastes are presented at one plant in Petit Rocher for which waste quantities are estimated at 2 million lbs/yr.* Sufficient area is available to accommodate over 15 years of production. When the trenches are full the initial trenches used should be reexavated, the stabilized sludge placed on the landfill and the trench reused.

Septic Wastes:

To include sludges, liquid, sewage cake and manhole sludges.

Disposal of these wastes shall be into prepared trenches dug to a depth of 6 ft (2 m) of which the upper 3 ft (1 m) is composed of granular soil. Should insufficient cover be available in the trench area it can be imported from that excavated from the adjacent fish or oily waste area. Approximately 7.4 acres is provided for septic waste disposal on site. At a production rate of 600,000 gal/yr, approximately 15 yrs of production can be accommodated. When the area is filled the initial trenches can be reused after the stabilized sludge is excavated and disposed of on the landfill.

---

*Verbal communication by Henri Hamel: planner
Belledune Planning Commission

ALL SPECIAL WASTE DISPOSAL, IF ACCEPTED BY THE OWNER MUST BE SUPERVISED AND DETAIL RECORDS KEPT.

8.9 Other Special Wastes

The subsoils of the landfill site are sufficiently impermeable to allow the disposal of certain other waste such as UFFI foam and asbestos. While the site is considered safe for these two wastes both must be disposed of properly and in accordance with Department of the Environment New Brunswick guidelines. It is not recommended that any other special waste as listed following be allowed into the landfill for disposal. Wastes such as pickling liquors, radioactive wastes, acids, organic chemical wastes, PCB (transformer oils), pesticides, insecticides, fungicides or agricutural chemicals should not be disposed of at the site.

While the geology of the site lends itself to the disposal of some of these special wastes this is Not Recommended without a detailed investigation and subsequent construction of an approved facility for handling and disposal.

8.10 Site Access Roads

Main access to the site is presently provided via Poplar Street, a gravel road. This access is considered sufficient for the proposed regional site. Should the proposed Bathurst-Janeville bypass be built consideration should be given to providing an access entering the rear of the landfill site. This access should be for use of refuse trucks only.

On-site access is presently provided by gravel roads. Site staff presently are of the opinion that these roads are sufficiently well constructed for on-site access. Future roads can therefore be constructed in a similar manner.

Initial site construction requires a main access road to be constructed from the main gate on Poplar Street, north along the site boundary past the maintenance building and then east parellel to the power line to Currie Street, which will be upgraded for the same purpose. The main access road has a recommended width of 30 ft (120 m). A service road should be constructed from the main access road to the landfill area of cell 2. This will cross the power corridor and lead to the cell gravel access road system on the cell.

Gravel access roads will be constructed as required and in a manner similar to existing construction practices. The sequence of construction will be from cell 2 to cell 3 and from cell 3 to cell 4. As cell 4 is reaching completion, a road will be constructed from cell 2 to cell 5 and as required to cell 6. Construction will then proceed to cell 7 and so on. Gravel road material should be reclaimed and reused as is expedient.

A perimeter gravel service road should also be constructed in the cleared fire zone area on the south side of the landfilled area.

Site access will be restricted and barred at Currie Street while on site access to the special waste areas, siltation ponds and the salvage waste area will be restricted by locked steel bar gates.

8.11 Buffer Zone

The entire operating area of the landfill is surrounded by a variable thickness buffer zone. This area will remain treed and will form a visual barrier. Along the southern edge of the site a buffer zone should be allowed to reestablish itself, as landfilling progresses, to give a minimum 20 ft (7 m) barrier. This must be viewed however, with light that the land to the south is undeveloped and treed and unlikely to be used for development.

8.12 Rodent Control

The area method of landfill operation utilizing compaction and daily covering make the inhabitation of the landfill by rodents difficult, as voids in refuse and food supplies are reduced through this method of operation. The presence of some rodents however, is still likely and control may be necessary through baiting or poison control. Any program to control rodents must be undertaken by a professional pest control organization and with the knowledge and consent of the owner. The damage of such programs to wildlife must also considered.

8.13 Gas Control

Methane gas will be produced at the landfill as a by-product of biological decomposition. Other gases such as nitrogen and carbon dioxide will also be produced.

To control methane in the landfill and to discharge this gas to the atmosphere, and in order to prevent dangerous accumulations, a series of gas vents will be installed. These vents are located across the landfill in each year cell and are installed as filling proceeds. A typical gas vent consists of a large diameter PVC or concrete perforated pipe filled with clean 4 inch (100 mm) stone, capped and vented. The pipe is installed to the full depth of refuse emplacement. Drawing 2665-1 shows the location of gas vents on the old landfill, while drawing 2665-3 shows gas vent location in the year cells.

A methane diversion trench around the maintenance building is not considered necessary as methane migration from the new landfill area is not considered likely.

8.14 Surface Water Control

Surface water control at the landfill is afforded by two systems, an external perimeter ditch which captures and diverts surface runoff external to the site; and a ditch adjacent to the active landfill area which controls the on-site runoff.

Perimeter ditching discharges into existing watercourses and prevents external surface water from entering the landfill. The area active or on-site landfill ditch collects runoff from the working face which is then channeled to a two chamber siltation pond. Settlement of the silt will take place prior to water discharge to the brook. The ponds will require periodic cleaning from removal of silt. A cleaning schedule will be designed by the owner.

Cleaning will likely take place in the late summer or late fall, during periods of low rainfall. The ponds may be drained or pumped dry with the silt being removed by backhoe or front end loader.

The ponds are sized utilizing the rational formula, which is a general method only. The ponds therefore, should be monitored over the active life of the site especially after heavy rainfall events and during spring thaw to ensure sufficient storage capacity is available. Should it be necessary the ponds can be increased in size as required.

These ponds, which will contain up to 155,000 gallons (706 m^3) of water, may also be used for fire protection on site.

8.15 Fire Protection

Fire protection must be afforded at a landfill due to the possibility of spontaneous fires or those caused by refuse or debris brought to the site. Such events occur from disposal of hot ashes. The maintenance building should house pumps and

sufficient hose to allow a reasnable fire fighting ability. These can be used in conjunction with the siltation (fire) ponds. On-site machinery will also be used to dig out the fire to permit dowsing. Approximately 1000 ft (300 m) of hose should be maintained at the site with the ability to call upon greater lengths if required. Five ponds may be constructed on site as required as landfilling proceeds.

All on-site vehicles should be equipped with dry chemical extinguishers of sufficient size to tackle a small fire.

To maintain good safety conditions on site, site personnel are not permitted to smoke while working in the area of the active landfill. Signs to this affect should also be posted for incoming vehicle drivers.

8.16 Litter Control

Good landfilling practices and regular daily covering of refuse will hold in check problems with blowing paper and other light debris. The existing site has no fencing to prevent or control this problem, which however, does not appear to be extensive. The isolation of the site, lack of residential development immediately adjacent to the site and the heavy screen of trees surrounding the site are considered sufficient reasons for not installing litter fencing. It should be realized however, that should litter control be necessary, due to greater expansion of open area created as and filling continues, fencing must be considered.

It is recommended that a good tree barrier be maintained around the site and that clearing of landfill area in front of the advancing face be regulated to allow clearing only for the next series of year cells.

8.17 Leachate Control

A survey of the existing landfill shows leachate to be poduced only in small quantities. Leachates, which are formed through the percolation of water through the landfill, in the present case appear to be retarded by the encouragement of surface runoff and the provision of relatively impermeable final cover material.

While it is difficult to predict both the quantity and quality of leachate generated in the landfill, their generation can be controlled to an extent where simplistic methods may be used to treat the leachate.

The conceptual design utilizes; top and side sloping over the completed cells; diversion of off-site surface water; the use of daily cover; and 2 ft (0.66 m) of clay soil final cover, to minimize leachate production and reduce the contamination potential of the leachate. During operation of the year cell rainwater and snow will have easy access to the refuse. Proper placement of daily cover however, will minimize penetration of precipitation.

The overall aim of the leachate control system must be to prevent generation of leachate to any large degree through the measures aleady stated. Treatment of leachate, should it become necessary, is expensive and requires continual monitoring. Leachate treatment is not recommended for the regional landfill in its initial stages.

The equivalent of approximately 8-10 years of refuse disposal (for the regional site) is contained in the existing landfill from which leachate production appears minimal. The small dyked areas at the extension of landfilling also appear to adequately contain and control the leachate through evaporation and biodegradation.

From this example it is reasonable to assume that similar leachate quantities may be produced at the new landfill. While precipitation during high rainfall months and during the spring thaw will increase the leachate produced, the quantity in the early landfilling years is likely adequately treated through dilution and discharge. The leachate collection system therefore outlets to the siltation ponds. Should monitoring of the leachate discharge from the ponds both from a quantity and quality viewpoint be found unacceptable without treatment, a recirculation system could be installed, whereby the leachate is collected, pumped back to the landfill and injected for passage through the refuse a second time. This allow biogradation to take place and the reduction of certain objectionable characteristics in leachate, such as B.O.D.

The leachate system proposed must be installed as filling proceeds (Drawing 2665-2). It consists of 6 in (150 mm) solid PVC pipe laid in a gravel envelope along the centre axis of the year cell (Drawing 2665-4). Prior to installation the cell is cleared, grubbed and the surficial granular soil removed for later use as cover material. The ground surface, of clay soil is graded to a 1% slope toward the centre of the cell along an east-west axis. Clay soil excavated during this exercise is to be used as final cover material for the preceding year cell. The solid PVC pipe and gravel envelope are then laid in the central depression thus created. The gravel envelope also covers side pipes, joined to the 6 in (150 mm) PVC main, at tees. These side drain pipes are slotted, 6 in (150 mm) in diameter and 10 ft (3 m) in length. Leachate will travel when collected, eastwards, along the main pipe which also slopes (a minimum of 1%) from west to east across the site and thus follows the natural ground surface. The initial first lift of refuse, 3 ft (1 m) deep, will be completed in an estimated three month period. The amount of precipitation entering the leachate system during this 3 month operation period is considered sufficently small, such that the entire cell leachate collection system can be laid at one time.

If the time of the opening of a new cell is controlled such that it is opened in early July, the first lift would be completed in early October. Closure of the old cell and emplacement of final cover would also then take place in summer i.e. (late June to late July).

The open ends of the leachate system, west of the advancing cell face, must be capped until the system is to be extended.

The collected leachate from the system is channelled through a series of manholes location at the eastern extremity of landfilling. These manholes, constructed in the initial refuse cells will form the points from which the leachate will be pumped if necessary for recirculation, (Drawing 2665-3). A gate valve therefore should be installed in the main 12 in (305 mm) solid PVC collection line which leads to the siltation pond. Such control will enable a minimum depth of leachate to be maintained in the manhole being pumped and also allow, at other times, controlled discharge of the leachate.

Controlled discharge of leachate should take place during the spring thaw, as at this time of year surface water flows are at their highest, as will be the silt and organic loadings. Both the dilution factor afforded by the water flow and the attenuation and fixation properties of the silt and organics will aid in safe discharge of small quantities of leachate.

A leachate recirculation system would consist of a pumping station located at the central collection point of the leachate system and PVC pipes to carry the leachate over the finished cells to designated infiltration or recharge areas. These may be gravel blankets constructed into and through the final cover or wells also penetrating the refuse.

8.18 Dust and Noise Control

The heavy clay soil on site and the more granular surficial soils do not easily generate dust even under extremely dry conditions. This together with the site isolation and screening afforded by the surrounding forest indicates that dust will not be a problem.

Noise is confined to the working face of the landfill, the maintenance buildings and the on-site roads. Again isolation and the heavy tree barrier cause noise not to be a problem.

8.19 Salvage Area

Should the owner desire, the landfill may accept salvageable goods such as car bodies, white goods etc. An area is provided for this. It is located south of the main entrance and has access restricted by a steel bar gate. Material stored there can be periodically removed for salvage. Articles to be accepted should be large and that may cause problems during landfilling such as machinery or car bodies. Items deposited there are not meant to be salvaged by the site staff but are there for temporary storage prior to removal for recycling.

Those articles destined for the salvage area can be so directed from the scale house where a key can be obtained from the operator.

8.20 Scavenging

It is strongly recommended that no scavenging be allowed on the site either in the salvage area or at the working face. Scavenging disrupts the process of landfilling and is dangerous both for the scavenger and equipment operator.

8.21 Equipment Requirements

The existing site equipment namely one D-6 Tractor should be increased to two such tractors. This is necessary to allow the additional work load encompassed by periodic ditch construction; maintenance; covering, for daily and final; cover stockpiling; excavation of cover; road maintenance and snow clearing.

When a backhoe is required for siltation pond cleaning, manhole installation and special waste trench construction it could be contracted on an as required basis.

8.22 Maintenance Building and Associated Structures

The present maintenance building and facilities owned by the City of Bathurst at the site are in good condition and well kept and are suitable to accommodate the additional loading and use associated with regionalization of the site. The additional equipment requirement, a second D-6 bulldozer, will however, require a storage building similar to that utilized by the present equipment.

The present building is single stored and contains the site office, workshop, garage and toilet facilities. A compound attached to the building is used for storage of city property.

The building access road leading directly from the site entrance and main access road must be maintained in a good state of repair at all times and the surroundings of the building kept neat and tidy.

Depending on the method of assessing incoming refuse, a weight scale may be required. This is located close to the site entrance and consists of a weigh scale and associated scale house. As the present disposal operation will more than double with regionalization and special wastes may also be received, the scales provide a means of recording all incoming refuse, its origin, type and volume. At this point also, directions and instuctions can be given to the driver as to the disposal of that particular waste. A record of all wastes entering should be kept to aid an efficient operation of the site. All traffic entering the site will be directed past the weight scale house.

A small shed, possibly skid mounted is to be provided on site at the working face for the on-site staff. The shed should be relocated periodically as landfill operations progress.

8.23 Reclamation

It is intended that the site be reclaimed simultaneously with landfilling. As each year cell is completed, the clay soil, excavated for leachate collection system installation in the next cell, is used to form the final cover material of minimum thickness 2 ft (0.66 m). Either prior to covering or after covering, two gas vents are installed through final cover. The slope of the final cover over the cell should be approximately 1 to 2%. The cell should then be grassed as this will prevent erosion of the cover and help regulate surface runoff and silt generation. It may be possible to establish tree growth on completed cells after a few years. The production of gas however, may prevent this. If each year cell is reclaimed as filling proceed the area necessary for maintenance and monitoring by site staff is consequently reduced, as is the end capital cost of closing this phase of the landfill.

Drainage ditches should also be allowed to regrass as this will help stabilize the slopes, prevent erosion and reduce siltation.

8.24 Cover Requirements

Daily cover requirements for the regional landfilling are considered adequate with an assumed average thickness of granular soil of 3 ft (1 m) over the site. To provide daily cover, of thickness 0.5 ft (0.15 m) over the lifts and side cell and internal walls of thickness 1 ft (0.3 m), requires approximately 75% of the granular soil excavated from beneath each cell.

Clayey soil excavated from beneath the cell prior to leachate collection system installation provides the soil required to form final cover over the preceeding cell. Additional clay cover if necessary will come from trench excavations in the special waste areas or maybe obtained by scavenging from other parts of the site. Additional granular soil may also be obtained this way. A low ridge located on the southern side of the site is composed of sandy silt and silty sands. If necessary this material could be excavated for daily cover requirements.

Gravel for roads, both temporary access upon the year cells, and for permanent on-site roads, must come from local gravel sources in the area (Figure 3). Several such sources lie within a short driving distance of the landfill. It is advised that the owner/operator investigate the feasibility of purchasing property on which gravel deposits are located. The cost of purchase may easily be offset by the cost of purchasing gravel over the life of the site.

8.25 Monitoring

The monitoring program proposed for the landfill will provide assurances of proper operation and protection of water supplies in the area. It also provides an early indication of leakage from the landfill and allows remedial measures to be undertaken prior to any contaminant leaving the site.

Four multi-level monitoring wells already exist at the site. Their locations are shown on drawing 2665-2 as are the locations of additional proposed monitoring wells. These monitoring wells should have piezometers in the bedrock and in the soil (multi-level).

These wells should be regularly monitored as determined by the Department of the Environment.

The effluent discharge from the siltation ponds and the leachate entering the ponds should also be regularly monitored. This is essential in order to determine the need for a leachate treatment system.

It is recommended that each monitoring well be sampled four times in the first year for the parameters stated below. The number of parameters may be then reduced to 4 or 5 selected indicator parameters. A full analysis however, would be undertaken on any sample displaying more than 15% change in any of the indicator parameters.

It is suggested that the siltation ponds and the leachate system should be sampled six times a year for the initial five years of operation. Monitoring can then be adjusted accordingly. The recommended parameters are:

BOD	Suspended Solids
COD	Dissolved Solids (Total)
TOC	pH
Total Nitrogen	Conductivity
Nitrate/Nitrite	Full Metal Scan
NH3	Phosphate (Total)

8.26 Closure of Existing City Landfill Area

Prior to and during conversion to a regional landfill, the existing landfill area must be closed. This will consist of application of final cover, regrading and sloping of the area, grassing and installation of gas vents.

Year cell 1 for the new landfill is located on the south side of the old landfill area. While filling this cell the new site facilities can be constructed. Final cover and grading of this cell must conform with that undertaken on the old landfill area. Immediately prior to final closure a series of manholes and a leachate collection pipe should be installed as shown on Drawing 2665-2. The exit pipes should be temporarily capped for later joining to the main leachate collection system.

9.0 ECONOMIC ASSESSMENT

9.1 Capital Cost Estimates

1.	On-site main access road including upgrading Currie Road	$ 67,500
2.	Three on-site gates (steel bar)	$ 5,000
3.	Scale facilities and scalehouse	$ 46,000
4.	Site work general landscaping etc.	$ 10,000
5.	Skid mounted shelter for personnel at working face	$ 6,000
6.	Clearing and grubbing initial work area (2 cells) and cell access	$ 23,000
7.	Clearing and grubbing roads	$ 5,000
8.	On-site perimeter service road	$ 22,500

9.	Siltation ponds, spillways and outflow structures	$ 42,000
10.	Leachate collection system, piping, manholes and gravel envelope, control value	$ 30,000
11.	Gravel stockpile for roads	$ 5,000
12.	Monitoring well system	$ 10,000
13.	Ditch construction for off-site runoff and runoff from active landfill plus culvert	$ 25,000
14.	Closure of Currie Road and signs	$ 1,500
15.	Clearing fire control zone	$ 15,000
16.	Site surveying and control	$ 10,000
	Sub-total	$323,500
	Contingency (15%)	$ 48,500
	Sub-total	$371,000
	Engineering (10%)	$ 37,100
	Estimated Capital Cost	$408,100

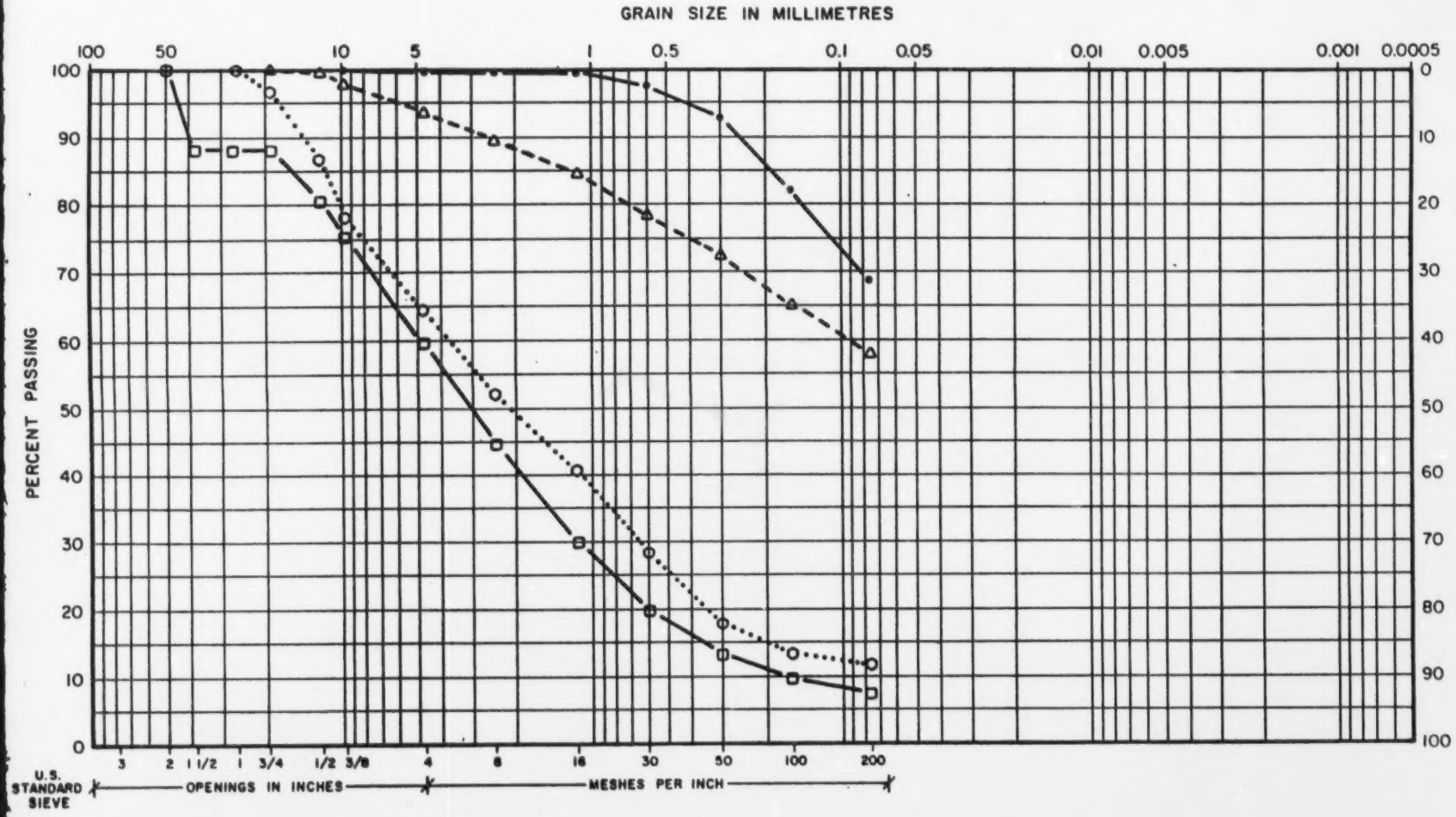
Should a new administration building be required, it is estimated that the capital cost of a one storey structure, approximately 7.5 m x 15 m in plan dimensions, would be $50,000. Thus, the total estimated capital cost would be increased to $458,000.

9.2 Annual Operating Costs

1.	Administration building heat, power, insurance etc.	$ 5,500
2.	Manpower	
	1 foreman/manager	$ 35,000
	2 dozer operators	$ 50,000
	1 scaleman	$ 20,000
	2 labourers	$ 36,000
3.	Equipment operating costs fuel maintenance repairs etc.	$ 80,000

4.	Gravel for roads construction and repair	$ 5,000
5.	Leachate collection system extension repairs, maintenance	$ 1,000
6.	Gas vents (2 per year)	$ 3,000
7.	Grassing for reclamation of completed cell	$ 5,000
8.	Monitoring of siltation ponds, wells etc.	$ 5,000
9.	Repairs, fences, signs, gates etc.	$ 5,000
10.	Site equipment 1 truck (½ ton) 2 D-6 tactors (one new, the other bought from City of Bathurst) Capital Cost Estimate $360,000 amortized over 10 years period at 12% interest	$ 57,000
11.	Contractual equipment fire truck, backhoe, fire pump etc.	$ 15,000
	Estimated Total Operating Cost	$328,000

APPENDIX A


GRAIN SIZE IN MILLIMETRES
100 50 10 5 1 0.5 0.1 0.05 0.01 0.005 0.001 0.0005
PERCENT PASSING
PERCENT RETAINED
0 10 20 30 40 50 60 70 80 90 100
U.S. STANDARD SIEVE
3 2 1 1/2 1 3/4 1/2 3/8 4 8 16 30 50 100 200
OPENINGS IN INCHES
MESHES PER INCH

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

UNIFIED SOIL CLASSIFICATION

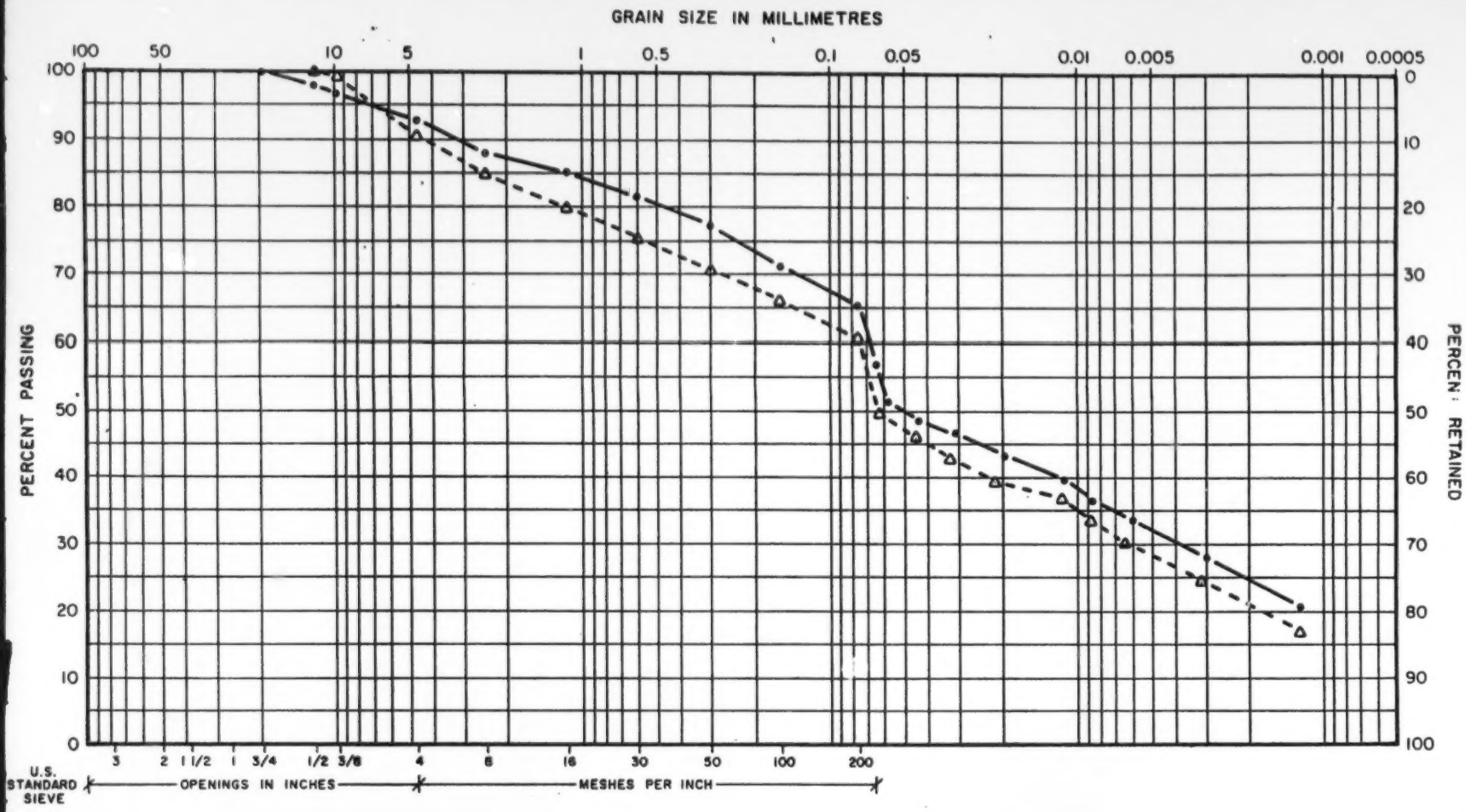
SOURCE	SYMBOL	SAMPLE	DEPTH	DESCRIPTION
TP 1	•——•		6.6 ft.	SILTY SANDY CLAY
TP 2	△– – –△		10.0 ft.	SILTY SANDY CLAY
TP 4	o·····o		3.2 ft.	GRAVELLY SAND
TP 6	□——□		2.0 ft.	GRAVELLY SAND

SUB SURFACE SURVEYS

GRAIN SIZE DISTRIBUTION

FIGURE No.

PROJECT 2665



GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

UNIFIED SOIL CLASSIFICATION

SOURCE	SYMBOL	SAMPLE	DEPTH	DESCRIPTION
TW 3	Δ- - -Δ		13.7 ft.	SILTY SANDY CLAY
TW 3	•——•		39.4 ft.	SILTY SANDY CLAY

SUB SURFACE SURVEYS

GRAIN SIZE DISTRIBUTION

FIGURE No.

PROJECT 2665

APPENDIX B

TABLE 1: WATER QUALITY ANALYSIS

Sample	1	2	3	4	5	6	7	8
Alumimum	0.60	0.247	0.285	0.169	0.292	0.512	0.22	0.237
Arsenic	L0.01	L0.01	L0.01	0.015	L0.01	L0.01	L0.01	L0.01
Barium	0.012	0.009	0.018	0.098	0.081	0.087	0.043	0.056
Cadmium	L0.001	L0.001	L0.001	0.004	0.005	0.005	0.004	0.003
Calcium	0.56	3.95	7.15	43.5	51.2	67.3	51.8	64.9
Chromium	L0.001	0.002	0.001	0.001	0.003	L0.001	0.002	0.002
Cobalt	L0.001	L0.001	L0.001	0.002	L0.001	L0.001	L0.001	L0.001
Copper	0.003	0.007	0.003	0.157	0.104	0.149	0.153	0.152
Iron	L0.001	0.25	1.76	0.005	0.087	0.269	0.003	0.003
Lead	0.024	0.006	0.006	0.043	0.06	0.04	0.063	0.027
Lithium	0.037	0.005	L0.001	0.05	0.02	L0.001	0.016	0.011
Magnesium	0.071	1.19	3.0	10.3	9.51	13.0	12.4	11.8
Manganese	0.002	0.004	0.01	0.285	0.543	1.14	0.331	0.466
Nickel	L0.001	0.004	0.005	0.011	0.011	0.01	0.013	0.009
Potassium	0.319	1.56	1.35	6.89	3.77	4.7	3.09	0.358
Sodium	119.0	5.37	19.7	32.0	28.1	35.7	95.4	153.0
Zinc	0.001	0.006	0.003	0.048	0.032	0.016	0.022	0.016
Chloride	5.5	7.2	31.0	6.4	7.5	12.0	15.0	18.0
Nitrate	L0.05	L0.05	L0.05	0.24	0.27	0.13	0.06	0.05
Sulphate	5.3	5.3	3.2	12.0	14.0	22.0	75.0	180.0
COD	5.0	34.0	41.0		398.0	28.0	146.0	
Alkalinity	230.0	12.0	23.0	192.0	200.0	254.0	300.0	348.0
pH	9.0	6.4	6.7	7.3	7.3	7.4	7.7	7.6
Conductivity	446.0	59.0	154.0	396.0	407.0	528.0	660.0	957.0

Sample 1 DOT Well
Sample 2 WSP2 (Brook)
Sample 3 WSP7 (Brook)
Sample 4 TW 4A (piezometer)
Sample 5 TW 4B (piezometer)
Sample 6 TW 4C (piezometer)
Sample 7 TW 5A (piezometer)
Sample 8 TW 2A (piezometer)

TEST PIT LOGS

Test Pit 1

0 - 0.5 ft	organic soil
0.5 - 2.0 ft	silty sand
2.0 - 10.0 ft	silt (no gravel)

Test Pit 2

0 - 0.5 ft	organic soil
0.5 - 2.0 ft	silty sand
2.0 - 9.0 ft	silty clay till with small boulders at 2.5 m

Test Pit 3

0 - 1.5 ft	silty sand
1.5 - 9.0 ft	silt with small cobbles

Test Pit 4

0 - 0.5 ft	organic soil
0.5 - 1.0 ft	leached horizon of sandy soil
1.0 - 1.5 ft	silty sand with gravel
1.5 - 6.5 ft	silt with cobbles
6.5 - 8.0 ft	gravelly sand (small quantity of water)
8.0 - 9.0 ft	silty clay till

Test Pit 5

0 - 0.5 ft	organic soil
0.5 - 6.0 ft	silt with small cobbles
6.0 - 7.0 ft	gravelly sand
7.0 - 9.0 ft	silty sandy till

Test Pit 6

0 - 2.0 ft	gravelly sand
2.0 - 9.0 ft	silty clay till

All classifications are based on visual examination.

TEST WELL LOGS

Test Well 1 (TW 1)

0 - 10 ft	silty gravelly sand
10 - 14.8 ft	gravelly sand silt
14.8 - 22.0 ft	silty clay
22.0 - 32.0 ft	soft red shale

Piezometer TW 1A installed to a depth of 30 ft (9.1 m).

Piezometer TW 1B installed to a depth of 15 ft (4.6 m).

Water was encountered at a depth of 14 ft (4.3 m) (less than 0.5 igpm (0.03 L/s)) while in the bedrock at 22 ft (6.7 m) water was estimated 10 igpm (0.76 L/s).

Test Well 2 (TW2)

0 - 0.5 ft	organic soil
0.5 - 42.0 ft	red brown silty clay few pebbles
42.0 - 65.0 ft	red brown silty clay very dense with large number of small pebbles
65.0 - 75.0 ft	red shale, soft

Piezometer TW 2A installed to a depth of 72.2 ft (22 m).
Piezometer TW 2B installed to a depth of 45 ft (13.7 m).
Piezometer TW 2C installed to a depth of 15.0 (4.6 m).

Water was encountered in the bedrock at 65 ft (19.8 m) and was estimated at less than 1 igm (0.076 L/s).

Test Well 3 (TW 3)

0 - 42.0 ft	red brown silty clay few pebbles
42.0 - 82.0 ft	red brown silty clay numerous pebbles

Piezometer TW 3A installed to a depth of 80.0 ft (24.9 m).
Piezometer TW 3B installed to a depth of 45.0 ft (13.7 m).
(due to collapse of the hole no piezometer was installed at a shallow depth)
No water was encountered some dampness was seen at depth

Test Well 4 (TW 4)

0 - 0.5 ft	organic soil
0.05 - 12.0 ft	sandy silty till
12.0 - 26.0 ft	red brown silty clay
26.0 - 32.0 ft	red shale

Piezometer TW 4A was installed to a depth of 30 ft (9.14 m).
Piezometer TW 4B installed to a depth of 16.0 ft (4.9 m).
Piezometer TW 4C installed to a depth 80 ft (2.44 m).

Approximately 5 igpm (0.38 L/s) of water was encountered at 12.0 ft (3.7 m) while in the bedrock at 26.0 ft (7.9 m) approximately 30 igpm (2.3 L/s) was estimated.

Test Well 5 (TW 5)

0 - 45.0 ft	red brown silty clay few pebbles
45.0 - 55 ft	silty gravel with water

Piezometer TW 5A was installed to a depth of 46 ft (14 m).
Piezometer TW 5B was installed to a depth of 10 ft (3 m).
Water encountered at 45 ft (13.72 m) in the gravel unit was estimated at 10 igpm (0.75 L/s). Due to collapsing of the gravel unit the piezometer TW 5A could only be installed 5 ft (1.5 m) into the formation.

All piezometers are 1.75 inches (44 mm) in diameter and consist of 5 ft (1.5 m) of slotted and wrapped PVC rigid pipe. After placement the piezometer was packed in place by clean sand and/or gravel with a minimum 3 ft (1 m) bentonite plug emplaced between piezometers.

All classifications are based on visual examination.